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Hygiene and Biofilm – a problem in the food industry

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Agenda

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- Introduktion
- Microbial analysis in production facilities
- Real life examples – Real challenges
- Test and certification of hygienic design
- DTU Test centre for Hygienic design

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IPU: A dedicated on-campus innovation team

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- A non-profit organisation at the TU of Denmark
- Research and development projects on contract
- Commercialisation of ideas, innovations, and patents
- 50 full-time staff
- 70+ associated DTU staff
- Co-location with DTU colleagues on campus
- Turnover: ~ 6 mill EUR/yr

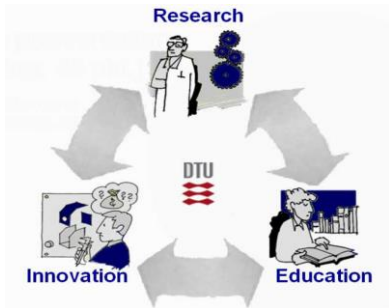


... since 1956

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DTU / IPU: Synergy in research, education, and innovation

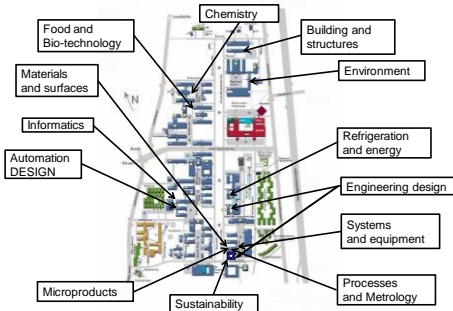
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Co-localization with DTU researchers on campus

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IPU Bio- and FoodTechnology

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Per Væggemose Nielsen
Group leader, M.Sc. Ph.D.



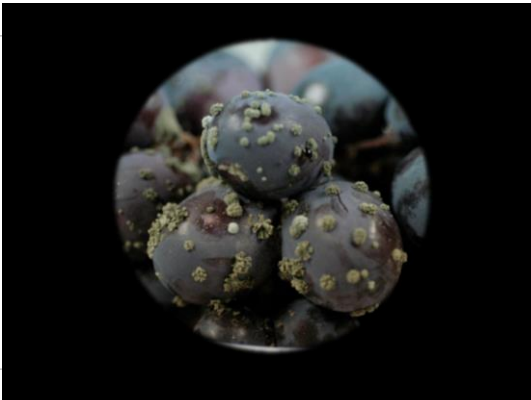
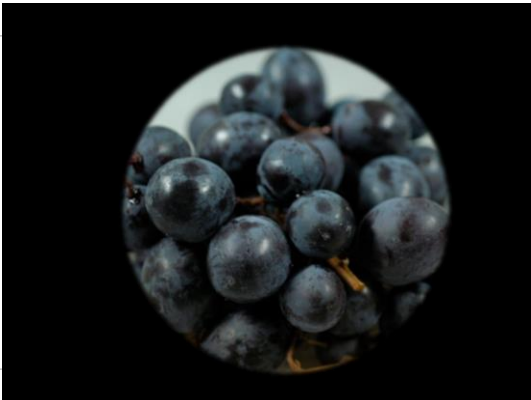
Henrik Ebbe Fallesen
Industrial PhD student M.Sc.

- Food safety, hygiene, preservation and packaging
- Food and BioTechnology in general.
- Interactions: biomaterials ↔ microorganism surroundings
- Experimental design and multivariate data analysis.
- Collaborate with DTU regarding research projects and project students.

Quantitative and qualitative microbial analysis of non transparent surfaces

- Correlation between surface modification, surface structure, clean-ability and adherence of microorganisms.
- Tests facilities for analysis of a wide range of microorganisms on non transparent surfaces

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Hygienisk design er ikke kun det du kan se

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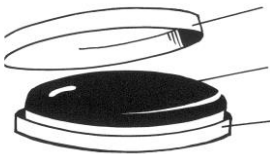
Mest anvendte teknikker: Case: Køletunnel

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Contact plate



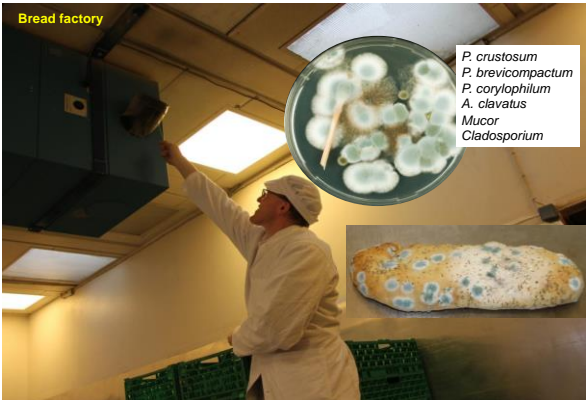
Test surfaces e.g. after cleaning and sterilization



Bread factory – bread cutter

10/20

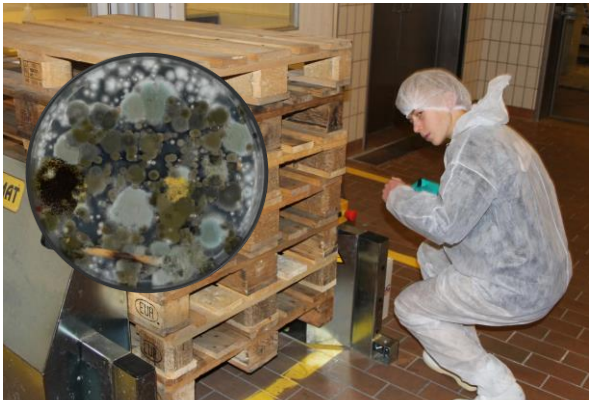




Hygienic design of production facilities



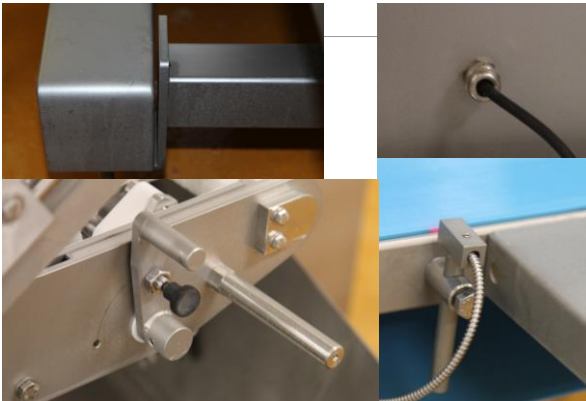
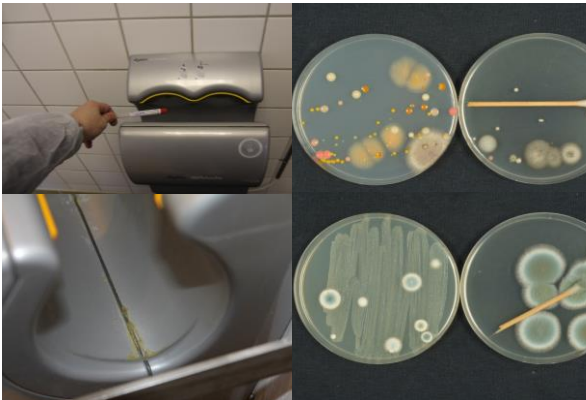
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Natural preservation

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→ Shelves in dairy should only be cleaned with cold water to avoid fungal contamination and off taste



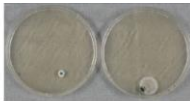
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Case – Skimmelsvampe vækst i dunke med ingredienser

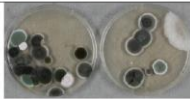
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Svaber fra den inderste plast pose om dunkene
P. rugulosum



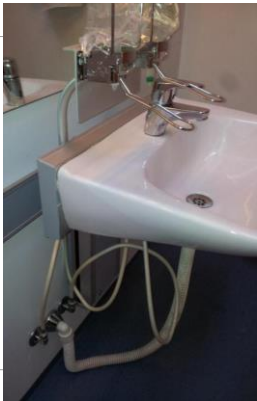
Svaber fra den yderste plast lag om dunkene
Trichoderma sp.
P. brevicompactum
P. pallans
Scopulariopsis sp.
C. herbarum
C. cladosporioides

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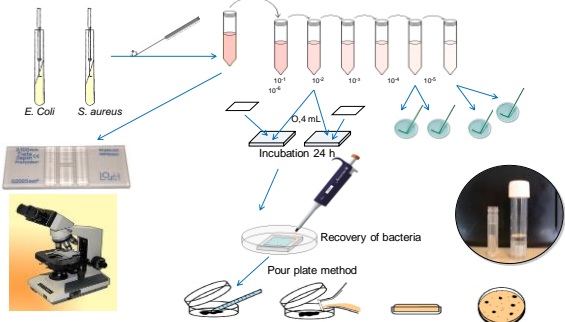
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Measurement of antibacterial activity on plastics surfaces ISO 22196

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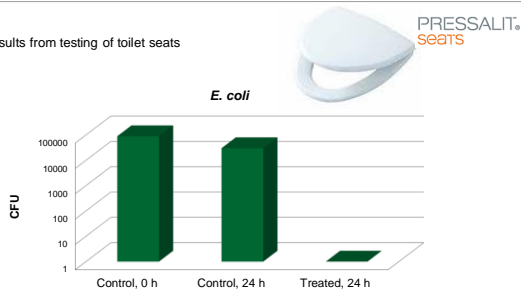
JIS Z 2801 and ISO 22196

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Measurement of antibacterial activity on plastics surfaces

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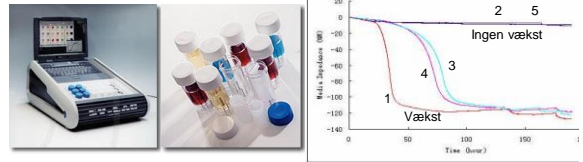
- Results from testing of toilet seats



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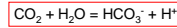
Impedans mikrobiologi

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Når organismer vokser udskiller de CO_2

Når CO_2 reagerer med en base, dannes ioner, som øger ledningsevnen og vækst kan bestemmes.

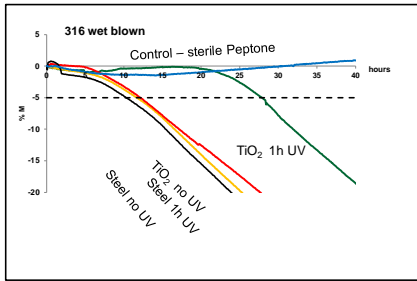


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Inhibition of bacteria on TiO_2 covered steal surfaces

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- 20 μl containing Ca. 5000 CFU *E. coli* bacteria added on each unit
- Incubate for 3 hours for adherence
- Irradiate UV 366 nm 1 hour
- No irradiation

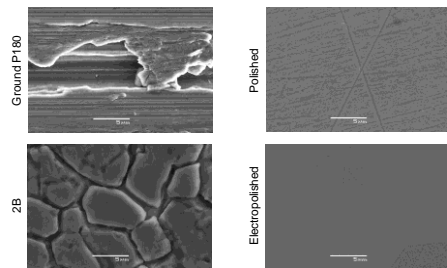


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Topography of different surfaces

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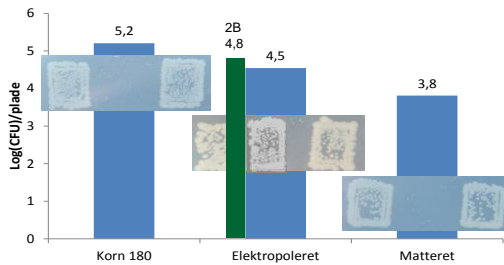
Examples of topography in x5000 times magnification



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Clean ability

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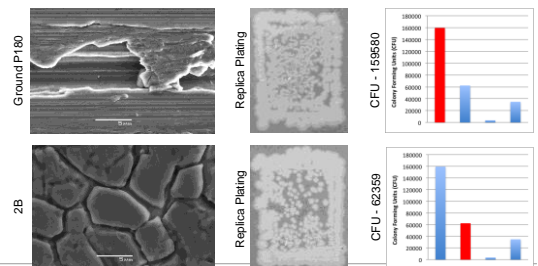
Agar-aftryk af 1x2 cm stålplader
CFU per plade er bestemt ved impedansmikrobiologi

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Obtained results by Impedance and Replica Plating

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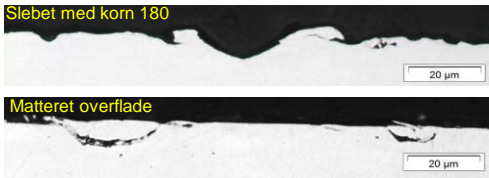
Examples of selected surfaces



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Tværsnitsprofiler af overflader

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Legislation and hygienic design

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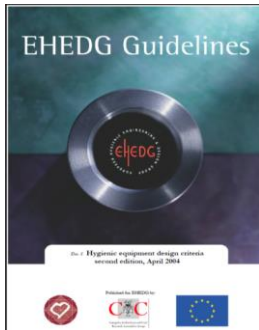
- EU Machinery Directive 98/37/EEC
 - Essential health and safety requirements relating to the design and construction of machinery and safety components
 - EC declaration of conformity for machinery – CE mark
- European Standard EN1672-2
 - specifies common hygiene requirements
 - identifies relevant hazards
 - design methods and information for use for the elimination or reduction of these risks.
- ISO 22000
 - Food safety management systems - Requirements for any organization in the food chain

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EHEDG evaluation and certification programme

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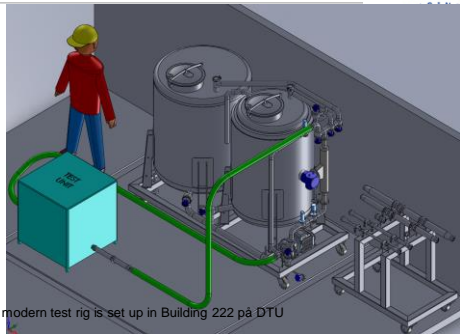
- Hygienic Equipment Design Criteria, Document No. 8 (1993)
 - A method for the assessment of in-place cleanability of food processing equipment, Document No. 2 (2000)
 - Hygienic design of closed equipment for processing of liquid food (Doc. 10)
 - Hygienic design of equipment for open processing (Doc 13)
- Information on all 41 guidelines on www.ehedg.org



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Test rig

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A top modern test rig is set up in Building 222 på DTU

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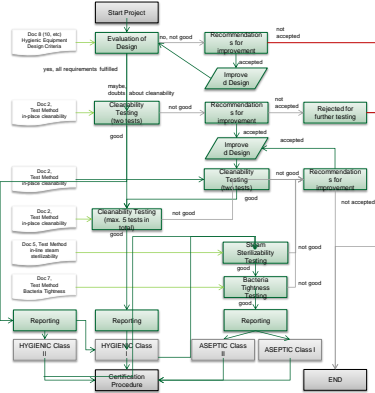
Test of closed equipment

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- Equipment is cleaned and sterilized (autoclave/chemical)
- Seals are checked for antibacterial compounds
- Equipment and reference tube are soiled with soured milk with the thermophile bacteria *Geobacillus stearothermophilus* = *Bacillus stearothermophilus*
- Equipment is pressurized and released 10 times in order for the soured milk to get in to all joints and seals. It is drained and dried.
- Equipment is cleaned according to a fixed method (mild cleaning)
- Equipment is taken apart and moulded in to agar. Reference tubes are filled with agar.
- Incubated at 58°C for 6 to 24 hours
- If dirt/spore is still present will it grow and give a yellow colour change.

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Testing Scheme for Process Equipment & Components of Type EL



©EHEDG, 2011



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Test of open equipment

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Soured milk with 0.012 % (w/v) Uranine AP



Standard cleaning 6 passages with a high pressure cleaner



Additional cleaning



Visualisation of soil under UV-lys

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Plastic pallet soiled

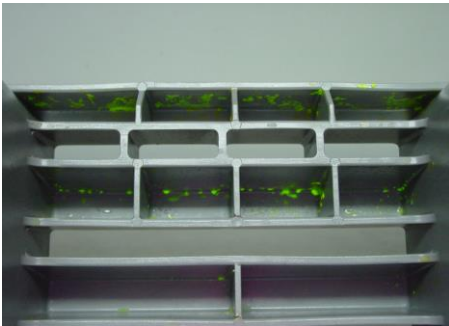
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After cleaning

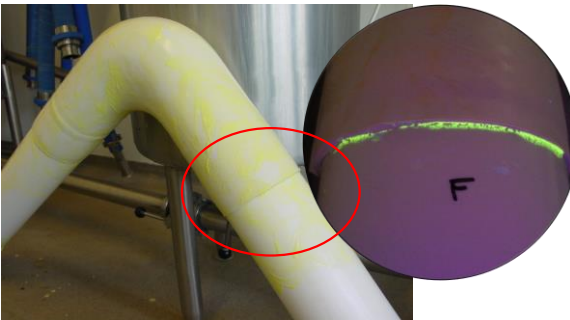
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Insulated tube

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